COMPARATIVE EVALUATION OF CORONAL SEALING ABILITY AMONG COMMERCIALLY AVAILABLE LIGHT CURE TEMPORARY RESTORATIVE MATERIAL WITH CONVENTIONAL TEMPORARY RESTORATIVE MATERIAL - AN IN VITRO STUDY

Dissertation submitted to

THE TAMILNADU Dr. M.G.R. MEDICAL UNIVERSITY

In partial fulfilment for the Degree of

MASTER OF DENTAL SURGERY

BRANCH IV

CONSERVATIVE DENTISTRY AND ENDODONTICS

MAY 2019

CERTIFICATE

This is to certify that this dissertation titled **"COMPARATIVE EVALUATION OF CORONAL SEALING ABILITY AMONG COMMERCIALLY AVAILABLE LIGHT CURE TEMPORARY RESTORATIVE MATERIAL WITH CONVENTIONAL TEMPORARY RESTORATIVE MATERIAL - AN IN VITRO STUDY"** is a bonafide record of work done by **Dr. Pon Mathini** under my guidance and to my satisfaction during her Post Graduation study period between 2016 – 2019. This dissertation is submitted to THE TAMILNADU Dr. M.G.R. MEDICAL UNIVERSITY, in partial fulfilment for the award of the degree of master of dental surgery in Conservative Dentistry and Endodontics, Branch IV. It has not been submitted (partial or full) for the award of any other degree or diploma.

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Duration of the course	**2016 – 2019**
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This thesis is the result of work done with immense support from many people and it is with immense pleasure that I express my heartfelt gratitude to all of them.

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Dr. Pon Mathini

CONTENTS

INTRODUCTION

INTRODUCTION

One of the key factors in predicting the failure or success of the root canal treatment is the use of an appropriate temporary restorative material during the course of root canal therapy. As these materials provide a temporary seal for the tooth preventing any percolation of fluids or microorganisms from the oral cavity during the course of root canal therapy. A temporary material should be easy to manipulate as well as dimensionally stable with good compressive resistance, abrasive resistance and it should be compatible with the intracanal medicament used during the root canal therapy.

Pulpal and periradicular diseases are most commonly caused by bacterial and its toxins[1,2]. Chemico mechanical debridement followed by sealing of root canal in all three dimensions is considered as the major predicting factor for the success of endodontic therapy.

Sometimes multiple visits are necessary during endodontic treatment as it is not possible to prepare, shape and obturate the tooth during a single appoinment[3].Therefore selection of an ideal inter appoinment temporary restorative material which provides a fluid impervious seal to prevent microleakage which can lead to failure of the root canal treatment is very important during multiple visit endodontic therapy to prevent bacterial infection.

A seal is defined as something that blocks entry (into or out of container or other object) hence, it is a difficult term to justify or use clinically since complete sealing of a tooth is "impossible" with currently available dental materials and due to the porous nature of the tooth structure itself (especially dentine but also enamel)[4].

The pathway of fluid through the restorative material into the tooth from oral cavity is known as microleakage[5].

Previous studies have shown that the success of the root canal therapy can be compromised by coronal leakage[6] and that during endodontic therapy the second most contributing factor for continuing pain following commencement of endodontic therapy is due to lack of satisfactory temporary filling[7].

According to Trope and Ray the quality of root canal filling is equally important to the quality of coronal seal regarding periapical health which they demonstrated by correlating between poor periapical status and inappropriate coronal restoration in root canal filled teeth[8].

Duration of usage of a temporary filling material also plays a vital role in determining the degree of coronal microleakage of the material used. Recent studies have proposed that immediate restoration should be done in an endodontically treated tooth as microleakage might occur within few days[9] and according to a study done by Torbinejad et al it was said that bacteria can pass along a root canal filling from coronal to the apical end within a period of 5 to 73 days[10], in another study conducted by Khayat et al by using fresh human saliva it was said that extensive leakage was seen in an unfilled cavity and it was completely penetrated by microorganisms within 48 days[11].

A number of materials are available for usage as temporary endodontic restorative materials and can be classified as, non eugenol containing materials such as zinc oxide-calcium sulphate, zinc oxide-eugenol based materials and light-cured resin based composite[12].

The coronal sealing ability of several materials have been studied over a period of time in search for an ideal temporary filling material to be used during endodontic therapy.

Hence this following study was contemplated to compare the coronal microleakage of light cure temporary filling materials (Clip manufactured by Voco and Systemp Inlay manufactured by Ivoclar Vivadent) with conventional temporary restorative materials (e – Temp manufactured by Diadent and Tempfil – G manufactured by Shivam Dental) which are commercially available in the market as it might provide some knowledge regarding the coronal sealing ability of these materials.

AIM & OBJECTIVE

AIM AND OBJECTIVE

The aim and objective of this study is to compare the coronal sealing ability among commercially available light cure temporary restorative material with conventional temporary restorative material over different periods of time

REVIEW OF LITERATURE

REVIEW OF LITERATURE

A study conducted by Anderson et al(1988)[13] to evaluate microleakage among three different temporary endodontic filling materials used to restore access cavities namely Cavit, Term and Intermediate restorative material using fluid infiltration technique and at different time intervals and at the end of the study it was concluded that Term and Cavit provided a leak proof seal whereas Intermediate restorative material showed significant microleakage after thermal loading during the 7 day interval.

A study was conducted to evaluate the sealing ability of two temporary endodontic filling materials (Term and Cavit) used to seal access cavity margins by Teplitsky and Meimaris (1988)[14] using dye penetration test with methylene blue and they concluded that Cavit provided a better marginal seal than Term and that it was unaffected by thermal cycling where as thermal cycling lead to increased microleakage in Term.

A study conducted by Bobotis et al (1988)[15] to evaluate quantitatively the sealing ability of temporary filling materials (Term, Cavit G, Cavit, Zinc phosphate cement, Intermediate restorative material, Polycarboxylate cement and Glass Ionomer Cement) used in endodontic therapy to seal the access preparation and it was concluded that Term, Cavit, Cavit G and Glass ionomer cement showed better seal when compared to Zinc phosphate cement during the test period of 8 weeks and Polycarboxylate cement and Intermediate restorative material are also less effective in preventing microleakage.

Melton, Cobb, and Krell (1990)[16] conducted a study to evaluate and compare a light cure temporary restoration Term with Cavit a self-polymerising temporary

restoration by using a carbon black protocol for coronal microleakage and at the end of the study it was concluded that Cavit produced an effective seal for access opening restorations whereas TERM did not prevent dye ingress especially in the proximal region than in the coronal margins.

A study conducted by B.M. Jacquot et al (1996)[17] to determine the microleakage among four temporary restorative materials (Cavit W, Cavit, Intermediate restorative material and Cavit G) for a period of over 9 days using impedance spectroscopy and based on the results there was no significant difference between Cavit W and Cavit whereas Intermediate restorative material showed more significant results than all the cavit formulations making it a better temporary filling material among the four study materials.

Barthel et al (1999)[18] conducted a study to determine the ability of coronal temporary restorations in preventing the corono apical leakage of bacteria, the materials used in this study are Intermediate restorative material, Cavit, Glass ionomer cement, Cavit in combination with Glass ionomer cememt and Intermediate restorative material in combination with Glass ionomer cement and the results of the study concluded that only Glass ionomer cement or Intermediate restorative material in combination with Glass ionomer cement was capable of preventing bacterial leakage for over a period of 1 month.

A study conducted to evaluate microleakage by Pai et al (1999)[19] among endodontic temporary restorative materials at three areas namely between cavity wall and access opening filling material, between orginal filling material and an additional patch of material used to fill a secondary opening in the first filling material placed after 14 days, between second filling material and cavity wall. The primary filling material

used is either Intermediate restorative material or amalgam and the secondary filling materials used were Caviton, Intermediate restorative material or a combination of both and based on the results it was concluded that there was significantly less micro leakage between secondary and primary restorative materials which were placed during different time periods than microleakage between cavity wall and the primary temporary filling material.

A study Conducted by M.B Uctash and A.C Tinaz (2000)[12] to evaluate the marginal seal using dye penetration test for four temporary restorative materials (Coltosol, Intermediate restorative material, Algenol, Fermit or Fermit-N) in endodontic access cavities and concluded that no significant difference was present in microleakage between low elasticity versus high elasticity light cured composite materials.

Liberman et al (2001)[20] conducted a study to evaluate the microleakage of cavidentin and Intermediate restorative material which were two widely used temporary filling materials following repeated vertical loading and based on the results it was concluded that without vertical loading both the materials provided similar seal quality whereas under repeated vertical loading of 4 kgs Intermediate restorative material showed superior seal when compared to Cavidentin thereby making it a suitable temporary filling materials in areas of occlusal load.

An vitro study conducted by Hanan Balto (2002)[21] to evaluate microleakage among temporary restorative materials used after root canal treatment namely Intermediate restorative material, Dyract, Cavit by using microbial marker containing Candida albicans and Streptococcus faecalis and at the end of the 30 day study it was concluded that Intermediate restorative material showed microleakage as early as 10

days when compared to Dyract and cavit which showed microleakage only after 2 weeks.

A study conducted by Lai et al (2007)[22] to evaluate the marginal leakage of temporary fillings namely Intermediate restorative material, Cavit, Copper Bands Cemented to Zinc phosphate cement and Zinc phosphate cement in complex endodontic access cavities by using dye penetration test and it was concluded that the Cavit group showed the least microleakage whereas the rest of the groups showed severe microleakage right from day 1.

Madarati et al (2007)[23] conducted a study to evaluate parametrically the coronal seal of four different temporary filling materials namely Coltosol, Intermediate restorative material. Glass Ionomer cement and Zinc Phosphate cement which are commonly used as filings to seal the access cavity following endodontic therapy over different time periods namely 1, 2 and 4 weeks and based on the results it was concluded that Glass Ionomer Cement and Coltosol showed superior seal when compared to Intermediate restorative material and Zinc Phosphate cements even after 4 weeks time duration and there was no significant difference between Zinc Phosphate and Intermediate restorative materials in their sealing ability during different time periods.

A study conducted using an experimental model by Jensen and Abbott (2007)[24] to evaluate dye penetration of interim fillings namely Cavit, Intermediate restorative material, Ketac silver, Ketac fil plus and Z100 composite resin in mesio occluso distal cavities during endodontic therapy under load with a multiple access chewing stimulator and the results concluded that Intermediate restorative material showed significantly more dye penetration than Ketav fil plus, Cavit, Ketac silver and Z100

resin composite and that no evidence of dye penetration was seen in Cavit models or Z100 resin composite models.

A study conducted by Koagel et al (2008)[25] to assess and evaluate the coronal micro leakage of Tempit, Tempit Ultra F, Cavit and Intermediate restorative material used as access restorations in endodontically treated teeth by using a fluid transport model woaking at 10 psi and based on the resuts no statistical difference was observed between Tempit and Tempit Ultra F as well as between Intermediate restorative material, Cavit and Tempit but comparitively less microleakage was seen in Tempit Ultra F when compared to Cavit and Intermediate restorative material.

A study conducted to compare sealing abilities among four temporary endodontic filling material namely Intermediate restorative material, Zinc oxide Eugenol, Md- Temp, Caviton by Dong-Ho Jung et al (2008)[26] using dye penetration with methylene blue under dynamic loading and based on the results it was concluded that MD- Temp and Caviton showed lower microleakage when compared to Zinc Oxide Eugenol and Intermediate restorative material under dynamic loading.

A study conducted by Chailertvanitkul et al (2009)[27] to evaluate the association between bacterial and dye penetration among interim restorations namely Cavit, Ketac silver reinforced with stainless steel band and Ketac silver used in endodontic therapy and it was concluded that stainless steel bands maintained the structural integrity in ketac silver fillings under masticatory load but does not prevent bacterial penetration and that no association was found between bacterial and dye penetration.

An in vitro study conducted by Shahi et al (2010)[28] comparing the dye penetration among four temporary filling materials namely Coltosol, Zamherir, Zonalin, and Intermediate restorative material and concluded that Zamherir and

Zonalin showed less microleakage when compared to the rest of the two temporary restorative materials.

A study conducted to assess the coronal sealing ability by Aledrissy et al (2011)[29] among hand mixed temporary materials versus readymade temporary restorative materials. The materials used were Litrak, Cavisol, Zinconol, Zinc phosphate cement and at the end of the study it was concluded that Cavisol produced better seal when compared to the rest of the test materials and thus readymade temporary filling materials produced a better coronal seal than hand mixed temporary filling materials.

An in vitro study conducted by Naseri et al (2012)[30] to analyse the coronal sealing ability among three temporary filling materials namely Zonalin, Cavizol, Coltosol by using dye penetration test with 2% methylene blue dye for a time period of 1 day to 4th week and based on the results it was concluded that all the experimental temporary filling materials showed increasing degree of micro leakage from 1st day to 4th week among which Zonalin showed comparatively more micro leakage than Cavizol and Coltosol during each time interval and no significant difference was obtained in the microleakage values between Cavizol and Coltosol.

Yun SM et al (2012)[31] conducted a study using four temporary materials namely Caviton, Intermediate restorative material, FujiII, Spacer to evaluate microleakage in class II access cavity preparation with glucose penetration model and at the end of the study it was concluded that significantly less microleakage was found in spacer and Caviton when compared to Intermediate restorative material and Fuji II and according to SEM observation more intimate tooth restoration adaptation was seen in Caviton and spacer than the rest of the two study materials and hence Spacer and Caviton are

considered superior temporary filling materials in class II access caities among the four study materials used for this study.

An ex vivo study conducted by G.P.V srikumar et al (2012)[32] to evaluate the marginal seal and coronal microleakage among hydrophilic temporary filling materials commonly used in endodontic practice following the use of walking bleach material and concluded that hydrophilic temporary filling material such as Coltosol F and Cavit G shows minimal dye penetration coronally when exposed to a mixture of walking bleach paste when compared to other temporary filling materials used during endodontic therapy.

An in vitro study conducted to compare three different restorative materials by Sagar et al (2012)[33] namely Mineral Trioxide Aggregate, Glass ionomer cement and flowable composite used as barriers to prevent coronal microleakage in root canal filled teeth and concluded that flowable composite and Mineral Trioxide Aggregate when placed at a thickness of 4mm as coronal restoration seals the root canal significantly when compared to glass ionomer cement and it was also said that placement of Mineral Trioxide Aggregate or Flowable composite as coronal restorations is advantageous in case of post preparation or retreatment as its removal is much easier.

Davut Celik et al (2013)[34] conducted a study among various temporary fillings namely Fermin, Cavit G, Coltosol F, Clip, Bms, Ketac Molar Easymix, ProFill, DuoTemp, or TempBond Clear with Triclosan Tfs for coronal leakage in endodontic access cavities using dye penetration test with methylene blue in extracted human teeth and concluded that all the test materials showed some microleakage with Ketac molar Easymix having the lowest leakage among the tested materials.

A study conducted by Natasha Capitani Symanski et al (2013)[35] evaluating the temporary filling material which are recommended by the Brazilian dental school during and after root canal treatment and said that the remaining tooth structure decides the choice of temporary filling material and from this study they concluded that pre mixed hygroscopic materials can be used for simple access namely on the occlusal or lingual/palatal surfaces for a period of 1 week but Glass Ionomer Cement is preferred for access cavities involving proximal surfaces and a minimum 3mm thickness of temporary restorative materials should be used.

Mohammadian M and Jafarzadeh-Kashi TS (2013)[36] conducted a study to compare the coronal sealing ability among 3 different temporary restorative materials namely Coltosol, Cavizol, Zonalin using dye penetration test and they concluded according to the results of the study that Cavizol and coltosol showed significantly less microleakage than Zonalin but there was no significant difference in microleakage between Coltosol and cavizol and that cavizol and coltosol can be used as temporary restorative materials for a period of less than a week.

A study conducted by Rajaa T. Sulieman (2013)[37] to measure microleakage among different temporary filling materials namely glass ionomer cement, , amalgam, zinc phosphate cement, temporary filling "zinc oxide eugenol" and concluded that when used as a temporary restorative material glass ionomer cement had superior effect and more ability than other test materials used in this study regarding the ability to reduce microleakage.

A study conducted to compare the micro leakage by Zalilah Tapsir et al (2013)[38] among various restorative materials namely Caviton, Kalzinol, GC Fuji II LC and GC Fuji IX used as coronal barriers in between endodontic appointments by using dye

penetration test with 2% Methylene Blue Dye for a period of 7 days and based on the results it was concluded that GC Fuji II LC showed the minimum microleakage among the test materials.

A study conducted by Cardoso et al (2014)[39] to evaluate the sealing ability of X Temp LC a new temporary restorative material with that of Coltosol and Vitro fill using a dye penetration test with 10% Indian ink for a duration of 14 days and at the end of the study it was concluded that there was no statistical difference present in the degree of microleakage between Coltosol and X Temp LC whereas Vitro Fill showed highest dye penetration which suggests that some degree of microleakage was present in all the experimental temporary filling materials.

An in vitro study conducted to evaluate the anti microbial activity and sealing ability among three temporary filling materials by Madhyastha et al (2014)[40] namely Caviton, Intermediate restorative material and Md Temp in which sealing activity was evaluated with dye penetration test using methylene blue dye and for antimicrobial activity Candida albicans and streptococcus mutans were used and based on the statistical analysis it was concluded that best marginal seal was produced by Intermediate restorative material when compared to Md Temp and Caviton and it was also said that effective marginal seal is very important for the success of the endodontic treatment.

An in vitro study conducted by Sadeghi et al (2014)[41] to compare coronal leakage among three different thickness of Angelus Mineral Trioxide Aggregate namely 2mm, 3mm and 4mm in endodontically treated teeth when used as intra orifice barrier and concluded that the coronal leakage was the same and there was no statistically significant difference based on the thickness of the material.

Santos et al (2014)[42] conducted a study to compare and evaluate coronal microleakage of some filling materials namely Cimpat Branco, Bioplic, and Maxxion R Glass ionomer cement used in between endodontic sessions in deciduous teeth and the study was done by using class V cavities and based on the statistical data it was concluded that microleakage was lower in Cimpat Branco when compared to Maxxion R Glass ionomer cement and Bioplic thereby making Cimpat Branco a very suitable material for restoration during between endodontic appointments in primary teeth than the rest of the two study materials.

An in vitro study conducted by Machado Cunha et al (2014)[43] to evaluate microleakage among three different temporary sealing materials namely Intermediate restorative material, Bioplic and Restorative Glass ionomer cement used for endodontic restorations and based on the results of the study it was concluded that all the study materials showed microleakage of different behaviour but comparatively bioplic and RGIC showed similar performances and a better outcome than Intermediate reatorative material.

A study conducted to assess and compare the sealing ability among three temporary restorative materials by Bodrumlu et al (2015)[44] namely first fill, Cavisol, Cavit-G when used in non-irradiated and radiated teeth to restore endodontic access cavities and it was concluded that no statistical difference was present among the study materials in the non irradiated group similarly sealing ability of Cavisol and Cavit G were unaltered due to radiotherapy where as the microleaekage of first fill which is a light cured temporary restorative material increased with radiotherapy as a result of enamel demineralisation thereby weakening the bond.

A study conducted by Udayakumar et al (2016)[45] to determine coronal leakage among different provisional restorations namely Coltosol F, Cavit, Intermadiate restorative material and Ketac Molar in combination with or without using an intra canal medicament namely Chlorhexidine and calcium hydroxide following exposure to human saliva and based on the results it was said that Cavit and coltosol F prevented bacterial leakage for up to 7 days and that there was less bacterial contamination in intra canal medicament treated samples for upto 14 days and thus it was concluded from this study that none of the test samples provided a reliable seal for more than 14 days and that the inter appointment duration should not exceed beyond 2 weeks when using these samples during endodontic therapy.

Markose et al (2016)[46] conducted a study in order to assess the sealing ability among various temporary filling materials used to seal the endodontic access cavities namely Intermediate restorative material, Fermit-N, Cavit-W, Zinc Oxide Eugenol and concluded that the entire specimen showed dye penetration except the negative control group and better sealing ability was shown by Fermit-N followed by Cavit- W and Zinc Oxide Eugenol and maximum dye penetration was shown by Intermediate restorative material when compared to rest of the study materials.

A study conducted by I. Kriznar et al (2016)[47] regarding the microleakage of bacteria in temporary restorative materials used (Cavit, Voco Clip,Fuji II LC,Excite and atetric Evoceram, Fuji IX, Adhese and tetric Evoceram) to restore endodontic access cavity and concluded that all the tested materials showed microleakage but cavit and adhesively bonded composites offered better sealing when compared to the other test materials.

A study carried out to compare and evaluate solubility, water absorbtion and sealing ability of GC Caviton, Cavit G and Intermediate restorative material by A R Prabhakar et al (2017)[48] and the results showed a statistical difference in the microleakage and water absorbtion values in which GC Caviton was superior to Intermediate restorative material and Cavit G thereby concluding that GC Caviton as the suitable and best temporary filling materials followed by Cavit G and Intermediate restorative meterial for interappoinment periods during endodontic therapy.

A study conducted by Maslamani et al (2017)[49] to follow up, evaluate and compare the quality of coronal restoration and its outcome at the completion of endodontic treatment and at the end of the study it was concluded that adequate coronal restoration have greater impact in post-operative periapical status when compared to the quality of root canal filling regarding the outcome of endodontic treatment.

S. Deepak and M. S. Nivedhitha (2017)[50] conducted a study to compare coronal microleakage among three temporary filling materials namely Cavit-G, Intermediate restorative material and Zinc oxide eugenol cement by using de penetration techniques and concluded that Zinc Oxide Eugenol showed more microleakage than Intermediate restorative material and Cavit-G but there was no statistical difference in microleakage between Intermediate restorative material and Cavit-G.

A study conducted by Pankaj K Srivastava et al (2017)[51] to assess the coronal leakage of temporary fillings in endodontically treated teeth and concluded that none of the temporary restorations (Coltosol F, Cavit , Ketac Molar , Intermediate restorative material) resist microleakage after 1 weeks' time.

MATERIAL AND METHODS

MATERIALS AND METHODS

MATERIALS USED

- 150 Extracted human premolar teeth (Both single and multi rooted)
- High speed airotor
- No 4 round bur
- Diamond fissure bur
- Periodontal probe
- 3% Sodium hypochlorite solution
- Conventional self cureTemporary restorative material
  (e –Temp &Tempfil – G)
- Light cure Temporary restorative material
  (Systemp Inlay & Clip)
- Scientec Incubator
- Methylene blue stain powder (MERCK pharmaceuticals)
- Nail varnish and sticky wax
- Sectioning motor (Ray Foster)
- Diamond disc
- Stereo microscope (LEICA M205C)

EXPERIMENTAL DESIGN

150 extracted human premolar teeth were selected for this study (Figure 1and 2). The teeth were cleaned of soft tissues and debris and were stored in saline to keep it moist throughout the procedure. Radiographic analysis of all the teeth were done to confirm the root canal anatomy and to check for the absence of abnormalities like root resorption and pulp calcification.

The teeth were divided randomly into 4 experimental groups (n-30 each), a positive control groups (n-15) and a negative control group (n-15).

ACCESS CAVITY PREPARATION

Standard endodontic access cavity preparation is done through the occlusal surface of the teeth with a airotor (high speed) under water coolant, with a round bur (no 4) for initial preparation and the cavity preparation is extended using a diamond fissure bur. For ease of preparation the teeth were mounted in custom made wax blocks made out of modelling wax (Figure 3).

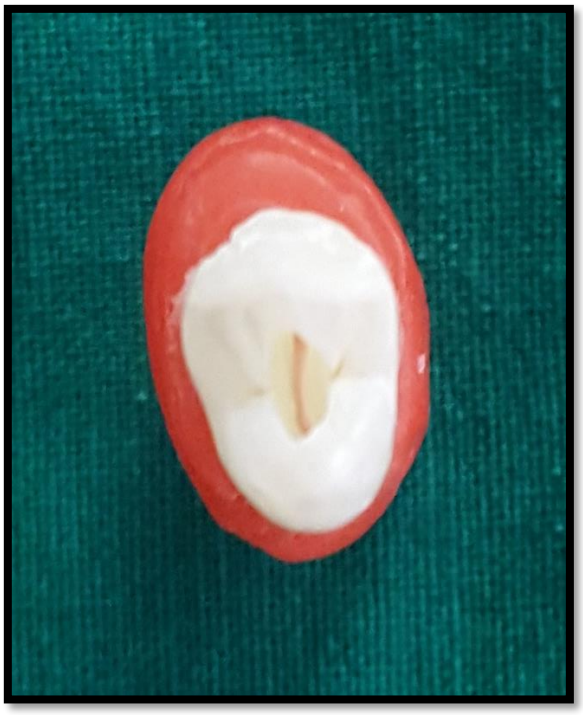
Following removal of pulp tissue and irrigation with 3% sodium hypochlorite solution, the pulp chamber was dried and a cotton pellet was packed into floor of the chamber and measured by periodontal probe such that it could accommodate 4mm thickness of temporary material (Figure 4).

TEMPORARY RESTORATION

Each experimental group was filled with one of the experimental temporary filling materials which includes two light cure temporary filling materials and two conventional temporary restorative materials (Figure 5). The positive control group received no temporary filling except a small cotton pellet in the floor of the pulp chamber in contrast to the negative control group which received no access cavity preparation.

Figure 1: Teeth samples for test group

Figure 2: Teeth samples for control group



Figrure 3: Access cavity preparation

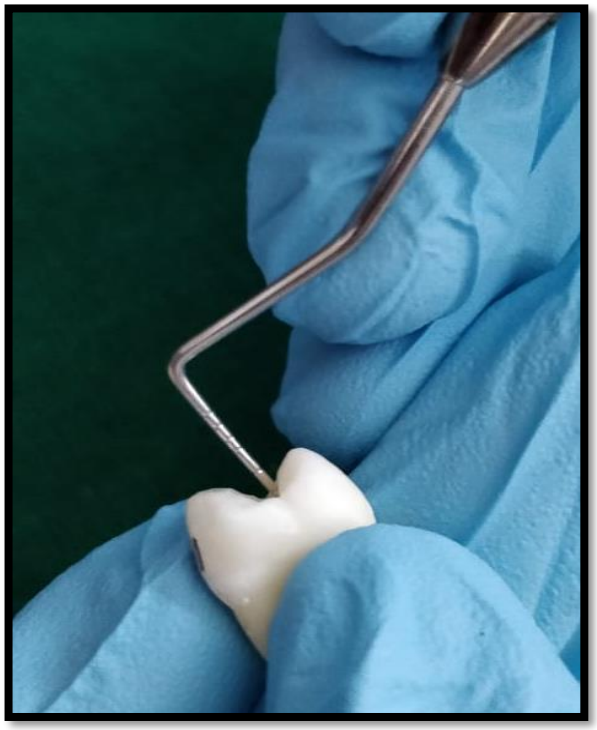


Figure 4: 4mm depth measurement with periodontal probe

Figure 5: Experimental temporary restorative materials

The groups were categorised as follows:

GROUP 1: Light Cure Temporary Filling Material (Systemp Inlay; figure 6)

GROUP 2: Light Cure Temporary Filling Material (Clip; figure 7)

GROUP 3: Conventional Self CureTemporary Filling Material (e - Temp; figure 8)

GROUP 4: Conventional Self CureTemporary Filling Material (Tempfil- G; figure 9)

NEGATIVE CONTROL GROUP: No Access Cavity Preparation Done

POSITIVE CONTROL GROUP: No Restoration Done

Figure 6: Light Cure Temporary Restorative Material (Group 1)

Figure 7: Light Cure Temporary Restorative Material (Group 2)

Figure 8: Conventional Self CureTemporary Restorative Material (Group 3)

Figure 9: Conventional Self Cure Temporary Restorative Material (Group 4)

All the specimens were incubated at 37degree Celsius (Figure 10) and 100% humidity using a scientec incubator for 1 day for setting of the test material. Following which all teeth specimens were covered with nail varnish (2 layers) leaving a thin space of 1mm surrounding the access cavity margins and Sticky wax was used to seal the apical foramina (Figure 11).

Each experimental group is further divided into two subgroups of 15 teeth each. All the specimens from one of the sub groups from each experimental group were immersed separately in freshly prepared 2% methylene blue solution prepared by mixing 6grms of methylene blue stain in 300 ml of distilled water (Figure 12, 13 and 14) for one day and similarly the remaining specimens from the rest of the sub groups were immersed separately based on the groups in methylene blue solution (2%) for 7 days. Likewise all the specimens from both the positive and negative control groups were immersed in the methylene blue solution (2%) for 7 days.

On completion of the experimental time the samples were sectioned in the bucco lingual direction by using a Ray foster motor (Model: AG03) with diamond disc (Figure 15, 16 and 17). Following which both the sections were fixed on glass slides and were observed and photographed using a stereo microscope (LEICA M205C) (Figure 18 and 19). The greatest dye penetration depth for each tooth sample was recorded. The scores were given based on the scoring criteria for evaluation of marginal seal in dye penetration test[39] (Figure 20, 21, 22, 23 and 24).

Figure 10: Scientec Incubator

Figure 11: Teeth samples coated with nail varnish and sticky wax

Figure 12: Methylene Blue Stain

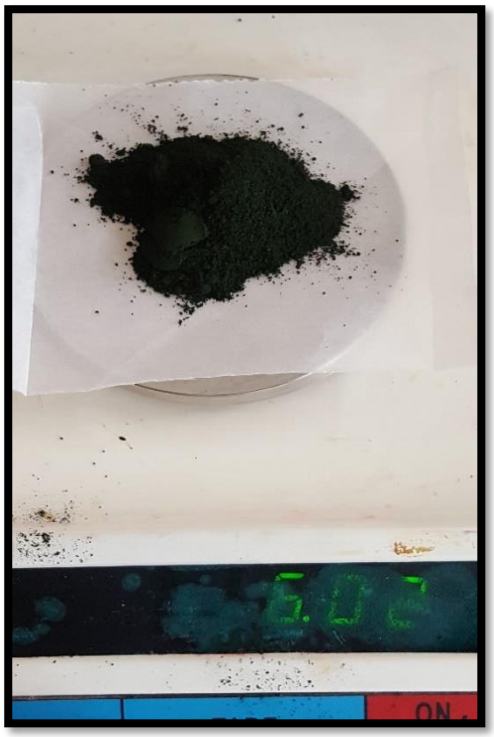


Figure 13: 6gms of Methylene blue powder

Figure 14: 2% methylene blue dye

Figure 15: Sectioning Motor (Ray foster)

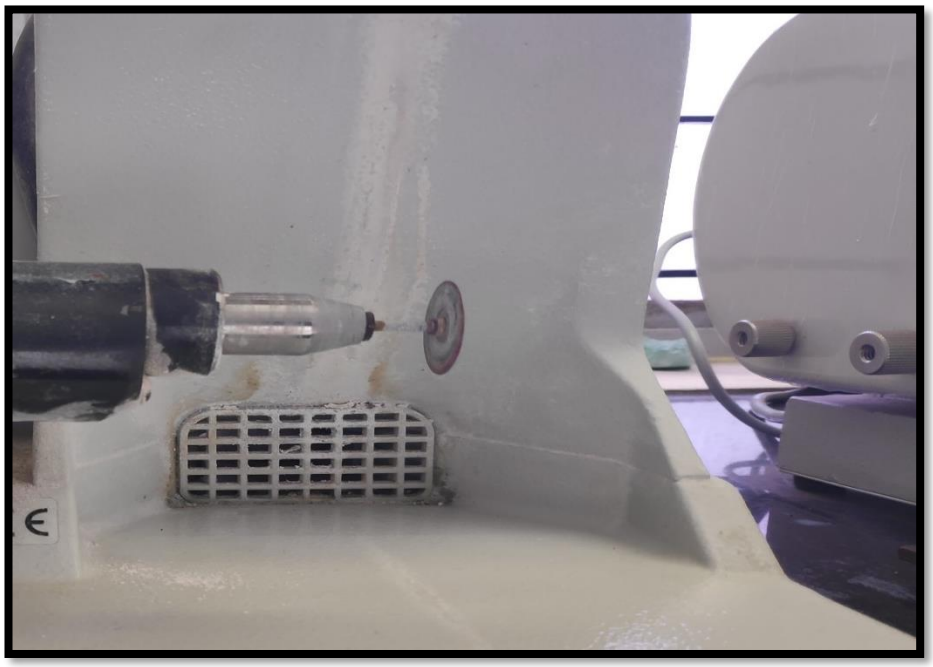


Figure 16: Diamond disc

Figure 17: Teeth sectioned samples

Figure 18: Stereo microscope (LEICA M205C)

Figure 19: Stereo microscope (LEICA M205C)

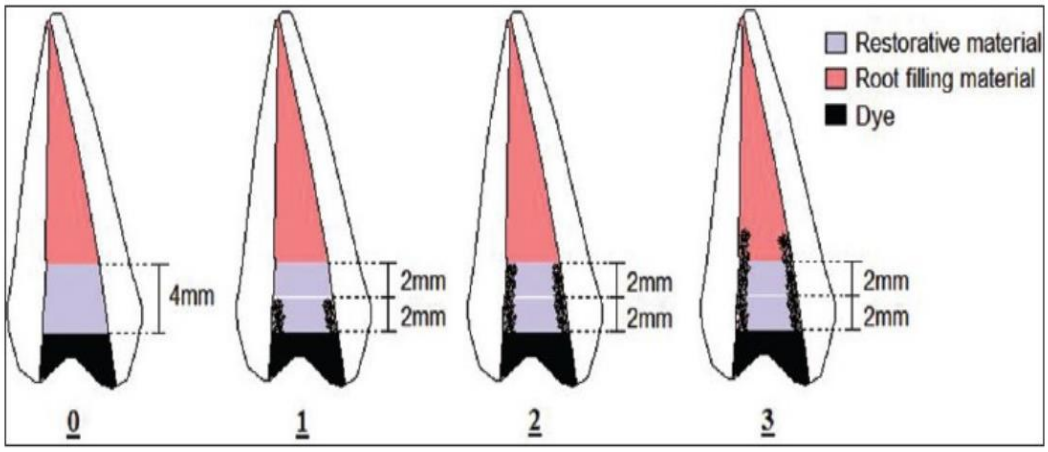
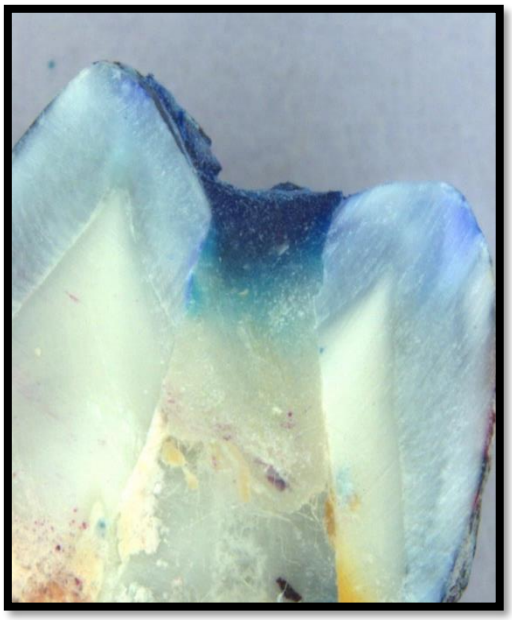
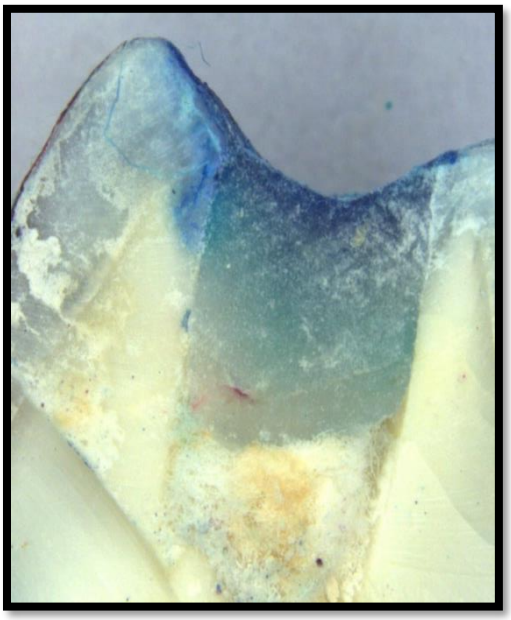


Figure 20: Criteria for evaluation of marginal seal in dye penetration test

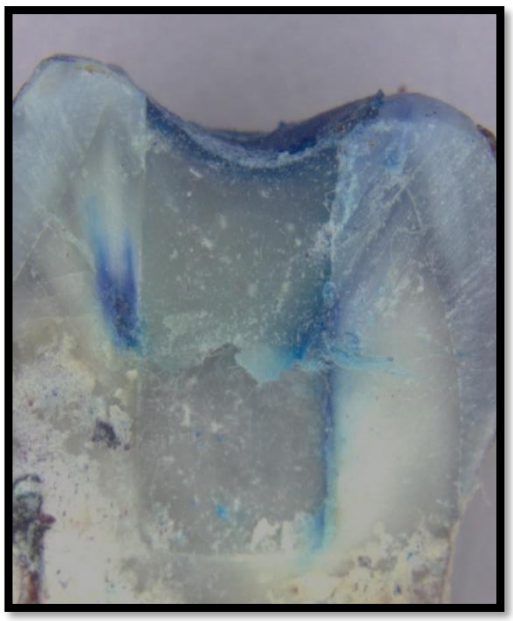
Fig 21: Microleakage scores in Group 1 Light cure temporary filling material



Score: 1 (< 2mm)

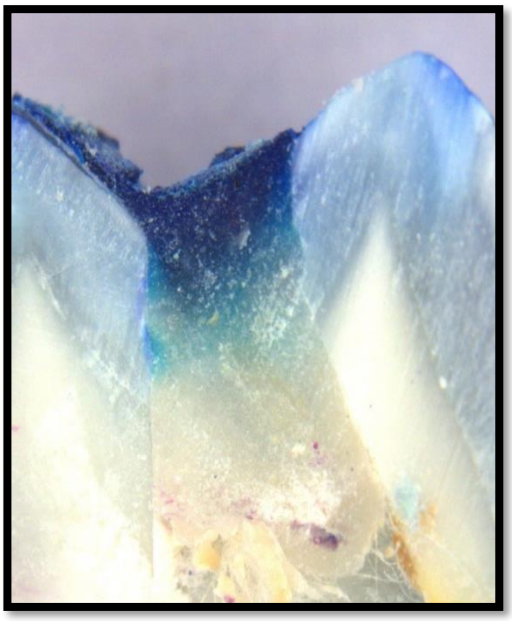


Score: 2 (>2mm)



Score: 3 (> 4mm)

Fig 22: Microleakage Scores In Group 2 Light Cure Temporary Filling Material



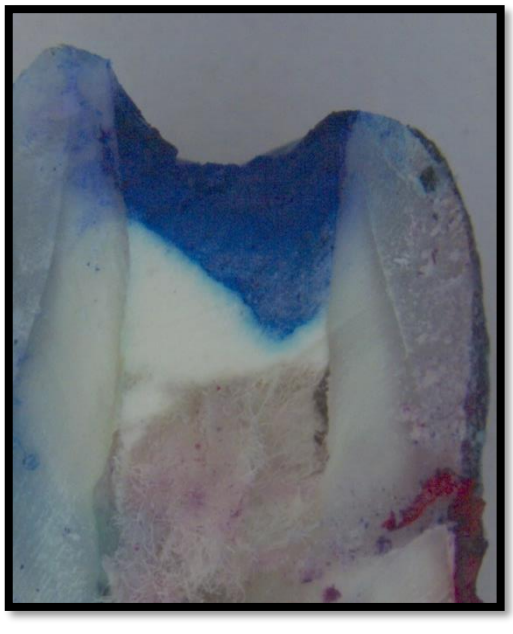
Score: 1 (< 2mm)

Score: 2 (> 2mm)

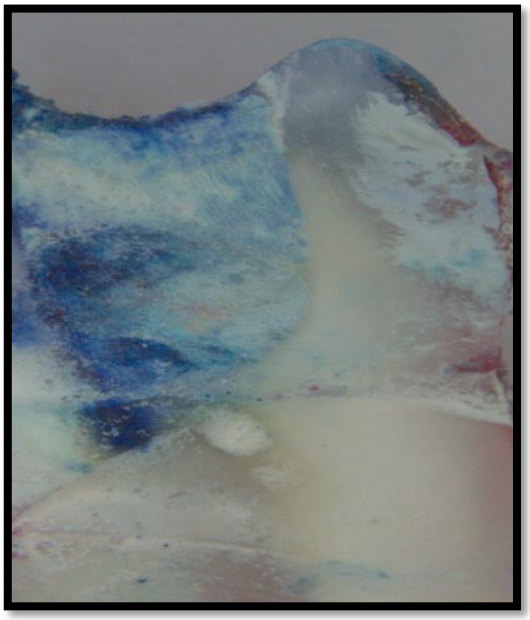
Score: 3 (> 4mm)

Fig 23: Microleakage Scores In Group 3 Conventional Temporary Filling Material

Score: 1 (<2mm)

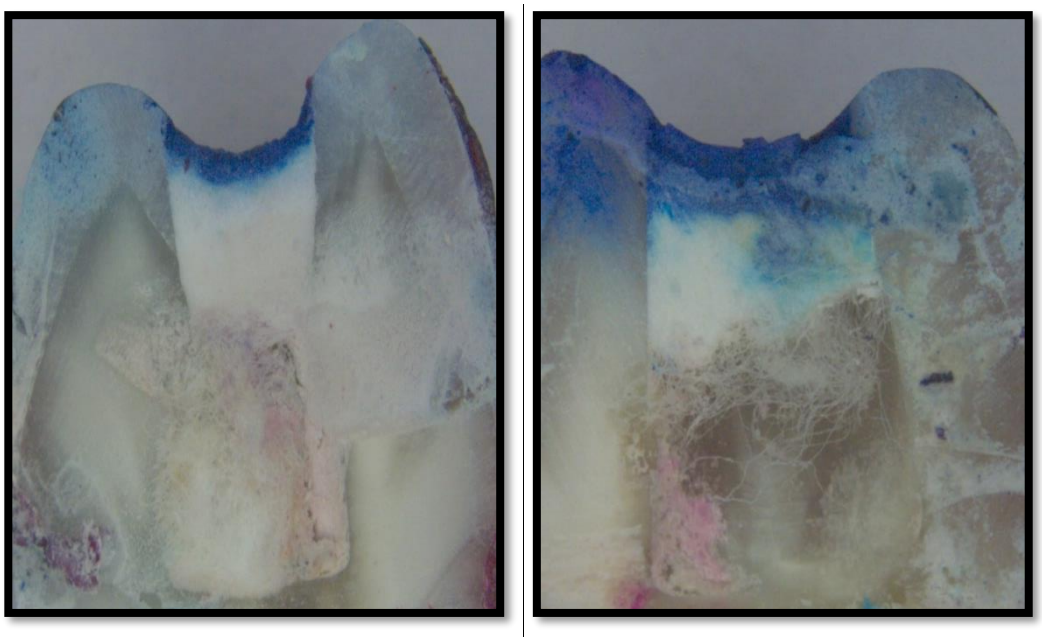


Score: 2 (>2mm)



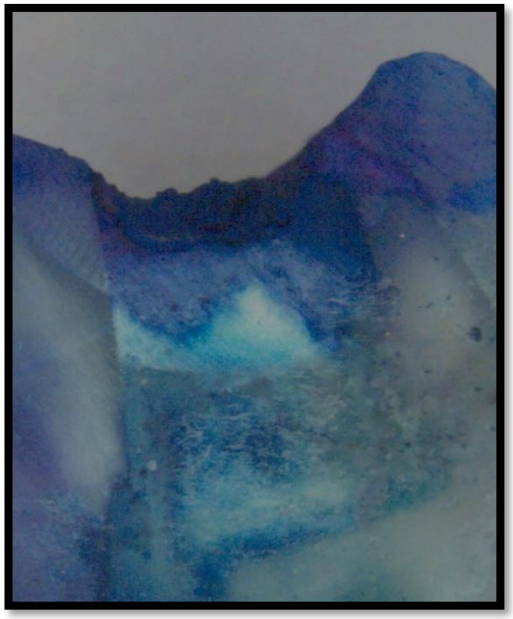
Score: 3 (>4mm)

Fig 24: Microleakage scores in Group 4 Conventional Temporary filling material



core: 1 (<2mm)

Score: 2 (>2mm)



Score: 3 (>4mm)

Statistical analysis was done using 20 SPSS software. Kruskal Wallis Anova and Median test were done to statistically compare between the groups after one day and seven days. Post hoc comparison between groups as well as intra group comparison between one day and 7 days was done using Mann whitney U test. P value of < 0.05 was considered statistically significant.

RESULTS

RESULTS

All the experimental temporary filling materials showed some amount of dye penetration. Negative control (No cavity preparation) showed no leakage whereas positive control (Cavity preparation without any restoration) showed complete dye penetration. The dye penetration scores based upon the time interval for each experimental groups are tabulated in TABLE 1.

The average microleakage scores for Group 1 (Light cure Temporary filling material) after 24hours were 1.2, for Group 2 (Light cure Temporary filling material) were1.1, for Group 3 (Conventional Temporary Filling material) were 1.2 and for Group 4 (Conventional Temporary filling material) were 1.4 and after 7 days for Group 1 were 2.33,for Group 2 were 2.13, Group 3 were 1.6 and Group 4 were 1.4 (TABLE 2 & 3).

On observing the microleakage scores from 24 hrs to 7 days between groups, there was no statistically significant difference in microleakage scores after 1 day but showed overall significant increase in the microleakage scores after the one week time interval (TABLE 2, 3 & 4).

On comparing the microleakage scores within the groups between one day and 7 days' time interval there was a highly significant increase in microleakage scores in Group 1 and Group 2 (Mean: Group1-1.2&2.33, Group 2-1.1&2.13, $P<0.0001$), whereas although there was an increase in the microleakage scores the difference was not statistically significant in Group 3 and Group 4 (TABLE 5).

On comparison between the four experimental groups during the 7 day interval statistically significant difference ($P<0.05$) in the microleakage scores was observed between Group 1 versus Group 3 (Mean: Group 1: 2.33,Group 3: 1.6, P value 0.013),

Group 1 versus Group 4 (Mean: Group1: 2.33,Group 4: 1.4,P value 0.003) and Group 2 versus Group 4 (Mean: Group 2: 2.13, Group 4: 1.4,P value 0.016), there was no statistical difference in microleakage scores observed between Group 1 versus Group 2, Group 2 versus Group 3 as well as between Group 3 and Group 4 (TABLE 6).

According to these results all the test materials showed increase in microleakage from day 1 to day 7 and on comparison at the end of one week Group 4 showed the least micoleakage scores followed by Group 3 and Group 2 whereas the maximum microleakage was shown by Group 1 (GRAPH 1).

TABLE 1: Dye Penetration Scores during Different Time Interval for Each Experimental Group

Dye Penetration Scores	Group 1		Group 2		Group 3		Group 4		Group 5	Group 6
	1D	1W	1D	1W	1D	1W	1D	1W	1W	1W
0	0	0	0	0	0	0	0	0	15	0
1	12	2	13	3	11	8	8	9	0	0
2	3	6	2	7	4	5	7	5	0	0
3	0	7	0	5	0	2	0	1	0	15
TOTAL NUMBER	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**

D- DAY, W- WEEK

INTERGROUP COMPARISON

TABLE 02: Comparison Between Groups After One Day Using Kruskal Wallis Anova

	Group	n	Mean	S. D	Mean Rank	Chi-Square	p value
one day	**1**	15	1.2	0.41	28.5	4.69	0.196
	2	15	1.1	0.35	26.5		
	3	15	1.2	0.45	30.5		
	4	15	1.4	0.51	36.5		
	Total	**60**					

TABLE 03: Comparison Between Groups After Seven Day Using Kruskal Wallis Anova.

	Groups	n	Mean	S. D	Mean Rank	Chi-Square	p value
Seven days	1	15	2.33	0.72	62.2	1.145	0.0001**
	2	15	2.13	0.74	53.33		
	3	15	1.6	0.73	40.53		
	4	15	1.4	0.63	37.27		
	5	15	0	0	8		
	6	15	3	0	75.5		
	Total	**60**					

P value-<0.001**- Highly significant

TABLE 04: Comparison Between Groups After One Day And Seven Days Using Median Test.

	Median value		Groups						Chi-Square	p value	N
			1	**2**	**3**	**4**	5	6			
One day	**1**	**> Median**	3	2	4	7			4.773	0.189	60
		<= Median	12	13	11	8					
Seven days	**2**	**> Median**	7	5	2	1	0	15	46.2	0.0001**	90
		<= Median	8	10	13	14	**15**	**0**			

P value-<0.001**- Highly significant

INTRAGROUP COMPARISON

TABLE 05: Comparison Within Group Between One Day And Seven Days Among All The Groups Using Mann Whitney U Test.

Groups	Within Groups	n	Mean	S. D	Mean Rank	Sum of Ranks	z	p value
1	**One day**	15	1.2	0.41	9.8	147	-3.82	0.0001**
	Seven days	15	2.33	0.72	21.53	323		
2	**One day**	15	1.1	0.35	10.17	152	-3.67	0.0001**
	Seven days	15	2.13	0.74	21.13	317		
3	**One day**	15	1.2	0.45	13.73	206	-1.2	0.195
	Seven days	15	1.6	0.73	21.53	323		
4	**one day**	15	1.4	0.51	15.77	236	-.19	0.849
	seven days	15	1.4	0.63	20.27	304		

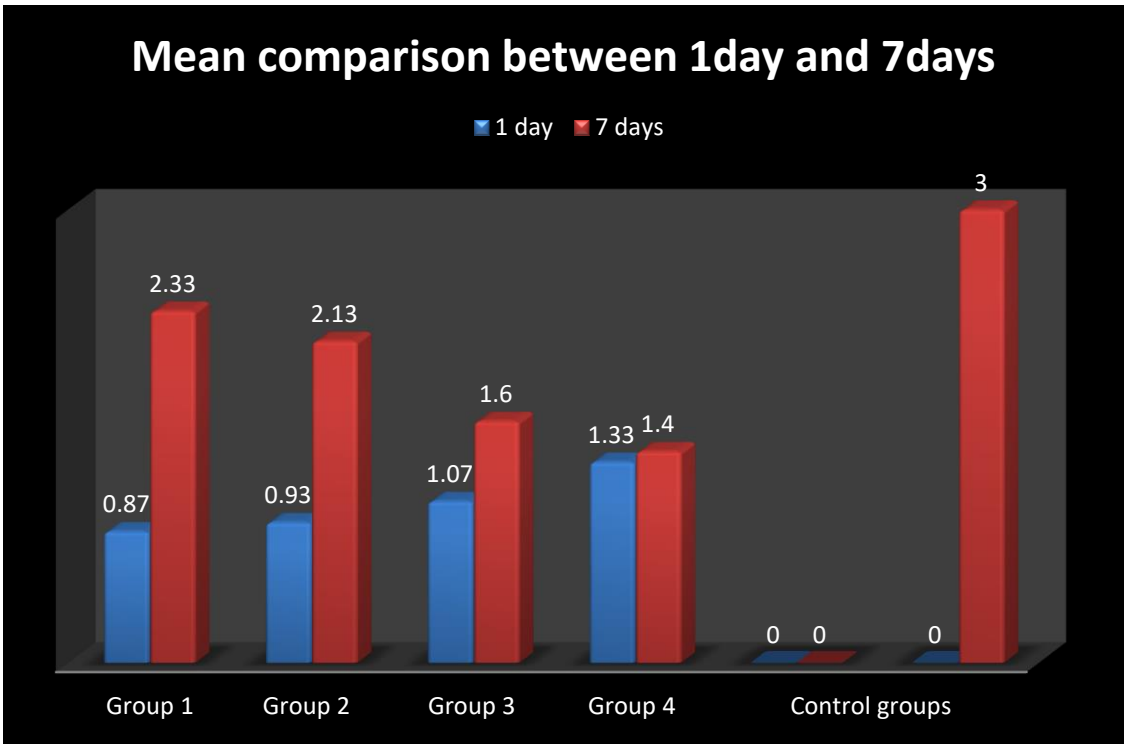
P value-<0.001**- Highly significant

TABLE 06: Post Hoc Comparison Between Groups Among 7 Days Interval Using Mann Whitney U Test.

7 days post hoc comparison		
Group vs Group	**mann whitney u value**	**p value**
1 vs 2	95.5	0.445
1 vs 3	56	0.013
1 vs 4	45	0.003
1 vs 5	0	0.001
1 vs 6	52	0.001
2 vs 3	69	0.057
2 vs 4	58.5	0.016
2 vs 5	0	0.001
2 vs 6	37.5	0.0001
3 vs 4	102	0.639
3 vs 5	0	0.0001
3 vs 6	15	0.001
4 vs 5	0	0.0001
4 vs 6	7.5	0.001
5 vs 6	0	0.0001

P value-< 0.05 - Significant

GRAPH 01: Mean Comparison between 1day and 7days



DISCUSSION

DISCUSSION

Microleakage is one of the most important risk factor associated with endodontic failure in multi visit endodontics. The prognosis of endodontic therapy is also predicted on the basis of the provisional restorative material and the main role of a provisional restorative material is to prevent the seepage of fluids and microorganisms from the oral cavity into the access cavity[51].

Temporary restorative materials in clinical endodontic practice must possess certain physical properties which allows immediate sealing of the access preparation[12].

According to a study conducted by Magura et al based on saliva penetration rate into the root canals said that if permanent restoration is not done for a duration of more than 3 months following an endodontic therapy root canal retreatment must be performed[52].

Various factors such as complexity of cases and multiple appointments requires the temporary material to produce a leak proof seal during the duration of the endodontic therapy[53].

Throughout dental history, temporary fillings have been done using a wide range of materials but none of the materials seem to fulfil most or all the properties of an ideal temporary restorative material[54].

Various in vivo and in vitro studies have been done to determine the ability of restorative materials to provide adequate coronal barriers during root canal therapy or prior to final restoration[55].

In the present study we examine and compare the microleakage between four commercially available temporary filling materials out of which the two are light cured

temporary restorative materials (Group 1& Group 2) whereas the remaining two are conventional self cure temporary restorative materials (Group 3& Group 4) by using dye penetration test with 2% methylene blue solution.

The most common method used for assessing microleakage is by dye penetration test using methylene blue dye[55]. The methylene blue dye has high water solubility as well as move by simple diffusion and not absorbed by hydroxyl apetite crystals present in the dentin[40] and that it has a molecular size smaller than that of the bacteria so it may be used as a tool to compare relative leakage[30]. Hence in the present study this explains the methodology for using 2% methylene blue dye to verify microleakage.

According to Webber et al a temporary restorative material should have atleast 3mm thickness to result in superior marginal sealing ability[56]. Hence the thickness of all the temporary restorative materials used in this present study was standardised to 4mm to test the microleakage present except for the samples in the positive control group in which no restoration was placed.

According to M.B Uctash and A.C Tinaz the technique for placing the experimental temporary filling materials into the access cavity preparation may have some adverse effects on marginal leakage of the material used[12] so in order to overcome this drawback all the experimental materials in this study were added by using incremental technique into the access cavities and furthermore the marginal sealing of all the samples was done by a single operator to reduce variability and as well as all the test materials were used according to the manufactures instructions to overcome the chances of manipulative variables.

To simulate the clinical condition the teeth samples were incubated at 37 degree celcius in 100% humidity to ensure complete setting of temporary filling material[30].

In this study sealing of the teeth samples was performed by using nail varnish in order to prevent the leakage of the dye through the tooth structure as observed by various authors such as Zmener O et al[55].

According to a study by Naseri et al, the sealing ability of temporary filling materials were tested for coronal sealing ability after 1 day, 1 week and 4 weeks as these are the most frequently used time intervals during dental practice between root canal therapy appointments or following obturation before the placement of a permanent restoration[30]. This justifies that in the present study the time interval considered to compare the difference in microleakage values between the temporary restorative materials was between one day and one week.

Two commercially available light cure temporary materials were used in this study out of which the first light cure temporary material (Group 1) is a single unit composite based temporary restorative material which has a command set and is based on Monofunctional Ethyl Triglycol Methacrylate And A Poly Esther Urethane Dimethacrylate similarly the second light cure temporary material (Group 2) is also a single component temporary restorative material which consists of Hydro Ethyl Methacrylate, Acrylate Esters, Butylhydoxytoludene And Polymers.

The remaining two test materials used in this study are conventional self cure temporary restorative (Group 3& Group 4). Both these materials are self cure temporary materials which are commercially available in a premixed state which sets under humidity and composed of Zinc Oxide and calcium sulphate.

According to the results of the present study all the experimental temporary materials devoid of their mechanism of setting showed an increase in the microleakage values from day 1 to 1 week which coincides with the results of the study conducted by Mohammadian M and Jafarzadeh-Kashi T S in which the microleakage of the temporary restorative materials assessed during three different times namely after 1day, one week and one month showed an increase in the amount of microleakage with time thereby indicating the decrease in the sealing ability of the temporary material over time[36].

According to the results in this study at the end of one week time interval Group 4 and Group 3 (conventional self cure temporary filling material) showed comparatively lesser microleakage. This can be attributed to the ability of these materials to set when in contact with moisture and can undergo hygroscopic expansion thereby maintaining a tight seal at the material and the tooth interface which has been stated by various authors such as Cruz et al and Lee YC et al[57,58].

The conventional temporary materials used in this study are premixed and ready to use, which can be quickly placed and adjusted into the access cavity. This reduces the inconsistencies associated with the chair side manipulations[57,58]. These superior manipulation properties were considered as supplementary factors responsible for good coronal sealing ability[59,12,60] which coincides with the results of this present study.

Various in vivo and in vitro studies have been conducted regarding the good sealing property of conventional self cure temporary restorative material (Caviton)[57,58] which has similar properties to our Conventional test materials (Group 3 and Group 4)[38] thereby coinciding with the results of our present study that the conventional temporary materials showed superior sealing ability.

Group 2 test material used in this study is a composite based temporary restorative material used without an adhesive system which has polymerisation shrinkage either due to lack of chemical bonds to tooth structure or due to lack of micromechanical retention[61]. Even though the water absorbtion property of resin based materials increases the volume it cannot fully compensate for the microgaps formed during polymerisation[62,63,64] which might result in microleakage.

Similarly according to S. Erkut et al, our Group 1 test material is a light polymerised, highly elastic resin based composite temporary filling material made by adding an antimicrobial agent (Triclosan) to another light cure filling material (Fermit)[65] and previous studies using this temporary filling material has resulted in considerable microleakage[66,12,67]. But certain controversies exists such as, according to M.B Uctash and A.C Tinaz light cure composite temporary filling materials lack microparticles which results in absorbtion of methylene blue which might be a reason for increased microleakage values[12].

This in vitro study has certain limitations such as it does not duplicate the oral environment such as presence of saliva, the data obtained through dye penetration test have been questioned by researchers who claim that this technique has large standard deviations and it is non reproducible[68,69].

Clinically in the oral cavity, according to Qvist V micoleakage can be impacted by the masticatory forces which may vary based on the variables such as Sex, location of the tooth, age and bruxism[70]. Hence in the present study occlusal load was not used because of the above mentioned differences.

According to B.M. Jacquot et al the marginal sealing ability of temporary filling materials can be adversely affected by temperature fluctuations[17] which was in contrast to Kidd who in his study stated that microleakage was not affected by thermal cycling[71]. Hence due to these controversies thermal cycling procedure was not performed in this study.

Considering these limitations further studies are required to evaluate micoleakage such as quantitative microbiological tests and quantitative evaluation as no method is ideal[43].

SUMMARY AND CONCLUSION

SUMMARY AND CONCLUSION

SUMMARY

The key factor for the success of root canal treatment depends on the prevention of microleakage of fluids and microorganisms from the oral cavity into the endodontic access through a temporary filling material either during the inter appointment time period or following obturation before the placement of a permanent restoration which can be prevented by using an appropriate temporary filling material which has superior sealing properties.

This study was performed to evaluate and compare the coronal microleakage between commercially available light cure temporary material and conventional temporary restorative material over different time periods as it might give an insight regarding the quality of these temporary restorative materials.

In this study one hundred and fifty extracted premolar teeth were used. The teeth samples were divided randomly into four experimental group with 30 samples each and two control groups with 15 samples each. The groups were categorised as follows:

GROUP 1: Light Cure Temporary Filling Material (Systemp Inlay manufactured by Ivoclar Vivadent)

GROUP 2: Light Cure Temporary Filling Material (Clip manufactured by Voco)

GROUP 3: Conventional Temporary Filling Material (e- Temp manufactured by Diadent)

GROUP 4: Conventional Temporary Filling Material (Tempfil - G manufactured by Shivam dental)

NEGATIVE CONTROL GROUP: No Access Cavity Preparation Done

POSITIVE CONTROL GROUP: No Restoration Done

Standard endodontic access cavities were prepared in all the teeth such that it could accommodate 4mm thickness of the experimental temporary restorative material. All the test groups were filled with their respective experimental temporary materials based on their specific manufactures instructions. After the completion of the experiment duration all the samples were sectioned in the bucco lingual direction and the sectioned samples where observed and recorded using a stereo microscope.

The mean values were computed and the mean values were calculated and compared. The difference in the mean scores were used to assess and compare the sealing ability of the temporary materials used in this study.

CONCLUSION

According to the results of this study all the test materials showed increase in microleakage from day 1 to day 7 and on comparison at the end of one week conventional temporary restorarive material (Group 4) showed the least micoleakage scores whereas the maximum microleakage was shown by light cure temporary filling material (Group 1).

This study provides an insight to the clinician regarding the quality of various commercially available temporary restorative materials thereby making it easier to select the suitable material for specific clinical conditions.

Thereby within the limitations of this study we conclude that all the materials devoid of the mode of curing showed increase in the microleakage values between day 1 to day 7 and that the conventional self cure temporary filling materials provide less

microleakage when compared to light cure temporary materials after one week time interval.

Though this study is not clinically evident, it suggests that temporary materials can be used only for a short duration of time and a permanent coronal restoration must be placed after root canal therapy at the earliest to avoid possible failures.

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BIBLIOGRAPHY

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